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בקשה לפטנט
Application for Patent

אני, (שם המבקש, מענו – ולגבי גוף מאוגד – מקום התאגדותו)
I (Name and address of applicant, and, in case of a body corporate, place of incorporation)

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(באנגלית) (English) Method of bipolar ion generation and ion generator

hereby apply for a patent to be granted to me in respect thereof.
מבקש בזאת כי ינתן לי עליה פטנט.

* בקשת חלוקה – Application for Division	* בקשת פטנט מוסף – Application for Patent of Addition	* דרישת דין קדימה Priority Claim		
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No. ____ מס'	No. ____ מס'			
dated ____ מיום	dated ____ מיום			
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Has been filed in case ____ הוגש בענין				
המען למסירת הודעות ומסמכים בישראל Address for Service in Israel Dr' Yefim Riskin 30 Dovrat Street P.O.B. 4787 Katzrin 12900				
חתימת המבקש Signature of Applicant Dr' Yefim Riskin				

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Method of bipolar ion generation and ion generator

Method of bipolar ion generation and ion generator

The method of ion generation and ion generator relate to methods and generators, using a single source of high AC voltage and at least, two air-ionizing electrodes for ion generation, and they can be used for bipolar air ionization, as well as in devices designated for eliminating of static electricity.

Background of the invention

All know ion generators have at least one screen, positioned in front the air ionizing electrodes. Normally, it is a conducting screen, however at times, device body elements, which are not necessarily conducting, might be used as a screen.

The screen acts as a passive electrode and it is needed for corona discharge generation between electrodes, during which ions are generated.

The screen may have a certain potential or alternatively be grounded.

Invention PAT ISRAEL N 119613 exemplifies a device designated only for unipolar ionization, which in fact, is one of its main disadvantages.

Pat.. U.S. N 4.740.862 shown in Fig. 1 exemplifies an invention, in which the potential of the screen is close to zero, since the screen is connected to the input of the operational amplifier.

Ion generators are also known which are provided with two conducting screens, mounted one after the other, in front of the ionizing electrode (See Pat. U.S. 4.757.422 and Pat. U.S. N 5.153.811).

The first screen in Pat. U.S. 4.757.422 has a zero potential and it serves to provide a corona discharge between this screen and the ionizing electrode.

The potential of the second screen in this invention is close to zero and it serves as an imbalance sensor.

The first conducting screen in Pat. U.S. N 5.153.811 Fig. 4 has a certain potential during operation.

The second screen in this invention is grounded.

The principal disadvantage of these and similar inventions, is their short operation life, caused by dust precipitation on the ionizing electrodes, which results in gradual decrease of ions emission until its complete cessation.

This is because the electric field capable to move ions, is concentrated only between the ionizing electrode and the screen, the potential of which is close to zero.

Since there are no construction elements generating electric fields external relatively to the apparatus beyond the screen, able to carry the ions away from the device, the ions are exported to the environment by an airflow experienced by the corona discharge area, namely the area between the ionizing electrodes and the screen.

In virtue of the fact, that the corona discharge area is actually an electrostatic filter, dust contained in the airflow precipitates on all the elements, forming the corona system, including the ionizing electrode.

Besides, the known inventions do not provide any indication of the reduction or ceasing of ion emission.

One of the objects of the present invention, is to generate stationary external electric field, assisting to carry the ions away from the generator without allowing airflow to pass through the corona discharge area.

In order to attain the object of the invention, voltages are applied to the screens while the currents emitted by air ionizing electrodes and flowing via the screens to the ground are uses as energy sources, and each of these currents is grounded via a separate electrical network constituting a voltage stabilizer.

Another object of the above invention is to provide self-balance of the positive and the negative output ion currents.

In methods and generators with balanced currents emitted by the ionizing electrode, the above object is attained by merely balancing the ion currents flowing via the screens to the ground.

In the proposed method the ion currents via the screen to the ground, are controlled by changing the screen potentials relative to the ground.

To do so, ion current emitted by each of the screens towards the ground from separated circuits constituting voltage stabilizers is passed through a capacitive network common for these currents.

In this case, when the screen currents are equal, voltage drop on the common capacitive network is equal to zero and the screen potentials are determined by their respective voltage stabilizers.

In case of screen currents imbalance, which might stem from the initial difference in distances from the ends of the ionizing ion electrodes to the screens, bias voltage is generated on the common capacitive network, which acts as negative feedback and redistributes the screen potentials relative to the ground, which results in screen ion current balance and, consequently, in self-balance of positive and negative output ion currents.

At the same time, the voltage difference between the screens remains unchanged and equal to the sum of voltage stabilizer voltages, which provides for steady value of the external electric field between the screens.

One of possible additional uses of the proposed method is its application in bipolar generators lacking separate balancing of air ionizing electrodes ion currents.

In this case, the balance between the positive and negative output ion flows, can be achieved on the expense of currents emitted by air ionizing electrodes flow to the ground through a capacitive network common for the ion currents emitted by the screens.

Indeed, when a screen is used, the output ion flow (for a single polarity) is determined from the following formula:

$I_{out} = I_E - I_s$, where:

I_{out} - output ions current

I_E - ions current emitted by the ionizing electrode

I_s - ions current emitted by the screen

Since ions current emitted by the electrodes and ion currents emitted by the screen, pass through a common capacitive network, in case of the output ion currents balance

$$I_{out+} = I_{out-}$$

the equation

$$I_{E+} - I_{s+} = I_{E-} - I_{s-}$$

is true and consequently, the voltage across the common capacitive network will be equal to zero.

In case of positive and negative output ion currents imbalance, bias voltage is generated across the capacitance, which results in redistribution of screen potentials relatively to the ground and consequently, in balancing of output ion current, as described above.

Even though in this invention the airflow passes beyond the generator borders, rather than the corona discharge area, which in itself considerably reduces the electrodes contamination with dust and considerably increases the service life, another object of the invention is supporting a constant ions emission level during the generator operation.

To attain this object, the ion currents emitted by the screens and/or ion currents emitted by the air ionizing electrodes, flowing from a circuit common to them towards the ground, are separated to a positive and a negative component and then, at least one of these flows, is used as a feedback signal, controlling the generator parameters.

In addition to the mentioned objects, one more object of this method is providing an indication of the need in cleaning the air ionizing electrodes from dust.

In order to attain this object, minimal value of the feedback signal below, which the preset level of ion emission is not maintained, is used as an indication signal.

The proposed method is implemented in ion generator, which has at least two air-ionizing electrodes, insulators with these electrodes mounted in them, conducting screens with electrodes arranged inside them, rectifying high voltage diodes, condenser, balancing ion currents emitted by the electrodes, stabilizers of the positive and negative screen voltage, condenser balancing the ion currents emitted by the screens, generator of high AC voltage, feedback network, comparator and indicator.

Drawings description

Fig. 1 is an electric diagram and construction of bipolar ion generator, containing separate elements for balancing the electrode-emitted and screen-emitted currents in order to balance the positive and negative output ion currents.

Fig. 2 is an electric network and construction of bipolar ion generator, in which a single balancing element is used for balancing the positive and negative output ion currents.

Fig. 3 is an embodiment of a high AC voltage generator, comparator and indicator.

As can be seen from Fig. 1, air ionizing electrodes 1 and 1a mounted in insulators 3 and 3a, are connected to one of the terminals of inversely connected rectifying high voltage diodes 4 and 4a, while the common connection point of the other terminals of diodes 4 and 4a, is via balancing condenser 14, connected to high potential terminal of AC voltage generator 8, the low potential terminal of which, is connected to the ground via a feedback network, consisting of two circuits branches connected in parallel, each consisting of diode and resistor connected in series 11&12 and 11a&12a, respectively, with diodes 11 and 11a in the branches, being inversely connected relatively to each other.

The common connection point of diode and resistor, of at least one of the circuits (for example 11&12), is connected to one of the inputs of comparator 9 to the second input of which reference voltages are applied via clamp 13, the comparator 9 output being connected to the control input of AC voltage generator 8 and to one of indicator 7 outputs, the other output of which is grounded.

At the same time, screens 2 and 2a with electrodes 1 and 1a, mounted in them are connected to high voltage terminals of voltage stabilizers, each consisting of Zener diode 5 and 5a and condenser 6 and 6a connected in parallel, while the common point of connection of low voltage stabilizer terminals, is connected to the ground via condenser 10.

The ion generator operation is as follows:

AC voltage generator 8 generates high voltage, which is applied to electrodes 1 and 1a via balancing condenser 14 and inversely connected diodes 4 and 4a.

Corona discharge is generated between electrodes 1 and 1a and screens 2 and 2a, and ion currents emitted by the screens flowing through Zener diodes 5 and 5a and condensers 6 and 6a generate voltages across screens 2 and 2a, the polarity of which corresponds to the polarity of the ions emitted by electrodes 1 and 1a, while the voltage between screens 2 and 2a corresponds to the sum of stabilization voltages of Zener diodes.

As can be seen from Fig. 1, screens 2 and 2a have openings used only for ions removal outside the corona system.

Ions are removed to the environment by the external electric field generated between screens 2 and 2a.

At the same time, currents emitted by screens 2 and 2a flow also in the common circuit - via condenser 10, which balances these currents.

Taking into consideration, that condenser 14 balances the ion currents, emitted by electrodes 1 and 1a, it is obvious, that the balance of ion currents emitted by screens 2 and 2a apparently results in automatic balancing of output ion currents at the generator output.

In case of imbalance of ion currents emitted by screens 2 and 2a bias voltage is generated across condenser 10, which equalizes the currents of the screens 2 and 2a.

Voltage across condenser 10 redistributes potentials across screens 2 and 2a relatively to the ground, leaving the difference of potentials between the screens unchanged.

In order to preserve constant ionization level during the generator operation, feedback network and comparator 9 used for controlling the

high AC voltage generator 8 parameters are added to it. Ionization level is maintained unchanged as follows:

Feedback network, consisting of two branches, connected in parallel, each consisting of inversely connected diodes 11 and 11a and resistors 12 and 12a connected to them in series, separate the currents of corona electrodes 1 and 1a, flowing via low potential terminal of AC voltage 8 to positive and negative components.

Owing to the equality of these currents, either one or both of them, can be used as a feedback signal.

The feedback signal reading point (for example a point of connection of diode 11 and resistor 12), is connected to one of the comparator 9 inputs.

Reference voltage is applied to the other input of comparator 9 via clamp 13, which determines the required ionization level.

Comparator 9 produces a control signal, which is applied from the output of comparator 9 to the control input of AC voltage generator 8.

Control signal changes the parameters of generator 8 (frequency of high voltage pulses or their amplitude), in this way maintaining the preset ionization level during the use, unchanged.

However, even such stabilization of output ion current is limited by the technical features of AC voltage generator 8.

In case of heavy contamination or failure of electrodes 1 and 1a, low level of feedback signal, can serve an indication of the need in maintenance (cleaning of electrodes from dust) or repair.

To do so, voltage controlling AC voltage generator 8 operation from the output of comparator 9, is applied also to indicator 7, consisting of a LED and Zener diode, the stabilization voltage of which is selected according to the minimal feedback signal, which does not allow to maintain the preset level of ions emission.

Fig. 2 shows ion generator embodiment, which includes one element used for direct balancing of the positive and negative output ion currents.

This embodiment does not include condenser 14, previously used for balancing electrodes 1 and 1a currents. For general balance condenser 10 is used. The low-potential input of generator 8 is connected to high-potential terminal of condenser 10, whereas the low-voltage terminal of condenser 10 is via feedback network 11, 11a, 12, 12a connected to the ground.

In this embodiment the ion generator operation is as follows: currents emitted by electrodes 1&1a and screens 2& 2a concurrently flow via condenser 10. However the currents of each electrode and its respective screen have opposite polarity, therefore the voltage drop across condenser 10 is determined by the difference between the positive and negative output currents of the generator.

This voltage drop across condenser 10 redistributes the potentials of screens 2&2a relatively to the ground, which results in balancing of output ion currents as described above.

Fig. 3 shows an embodiment of AC voltage generator 8, comparator 9 and indicator 7 in the proposed ions generator.

Comparator 9 consists of two operational amplifiers 91 and 97 powered via terminals 95 and 96. Operational amplifier 97 is used as a noninverting amplifier with amplification coefficient equal to 1 and it is used to obtain high resistance at the comparator input.

Operational amplifier 91 is a comparator used for comparing of two voltages - feedback voltage and reference voltage applied to the inverting input of amplifier 91 via resistors 94 and 93. Integration element - condenser 92 is connected in the feedback circuit of amplifier 91.

Generator of high AC voltage 8 is a standard relaxation generator, used for high voltage generating, step-up pulse transformer 84.

Generator 8 is powered from the mains via terminal 81 and the ground.

Generator 8 consists of diode 82, bi-directional thyristor (SADAC) 83, condenser 85, transistor 87 whose collector-base junction is used as an adjustable resistor, as well as resistor 86, via which current is determined to the emitter-base junction of transistor 87 which is determined by the control voltage applied from the output of comparator 9.

Generator 8 relaxation time is determined by condenser 85 charging current, which in turn depends on the control voltage produced by comparator 9.

Generator 8, feedback network 11, 11a, 12, 12a and comparator 9 constitute a standard current stabilizer in which relaxation frequency is used as an adjustable parameter of AC voltage generator 8.

At the instant, the above stabilizer fails to provide preset level of ions emission, meaning that comparator 9 supplies maximal control voltage to generator 8 and the generator operates at a maximal possible relaxation frequency, this very voltage opens Zener diode 71 in indicator 7 and current flow is initiated via diode 72 (LED), which indicated the need in preventive cleaning of electrodes or their repair.

Example of performance of the ion generator subject of the application:

Amplitude of positive and negative pulses - 6 kV

Pulse duration - $15 \cdot 10^{-6}$sec

Initial pulses frequency - 20- Hz

Positive and negative ions emission level - 10^{10}ion/sec

Balance ±2%

Period of continuous generator operation without a decrease in ions emission - 7 months.

What is claimed is:

1. Method of bipolar ion generation including generation of AC voltage, separate application of positive and negative voltages to at least two air ionizing electrodes mounted in separate conducting screens, including balancing of ion currents emitted by these electrodes, in which for a purpose to generate external electric field and for balancing the positive and negative output ion currents, bias voltages are provided to the screens for which goal each ion current flowing from ionizing electrode to the screen is then passed to the ground via a separate electric network constituting a voltage stabilizer and via capacitive network common for these currents.

2. Method of bipolar ion generation according to claim 1, in which, in case the balancing of ion currents emitted by electrodes does not take place, these currents are provided to the ground via capacitive networks common for ion currents emitted by the screens

3. Method of bipolar ion generation according to claims 1, 2 in which in order to maintain the preset level of ion emission during operation the screen currents and/or ionizing electrodes currents flowing to the ground are separated to positive and negative components, furthermore at least one of these currents is used as a feedback signal for stabilizing the ion emission level.

4. Method of bipolar ion generation according to claim 3, in which the minimal value of the feedback signal, beyond which the preset level of ions emission is not provided, serves an indication of the need in electrodes cleaning from dust.

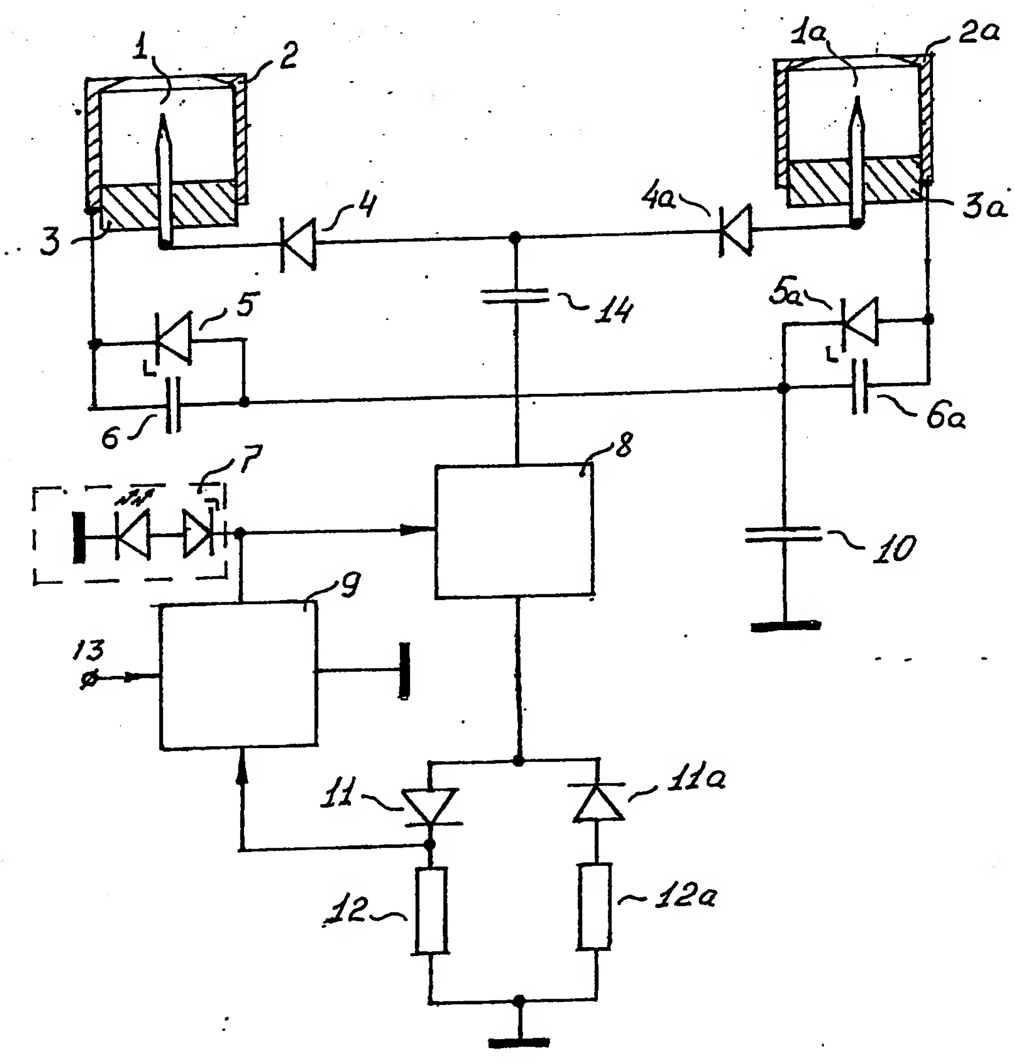

Fig. 1

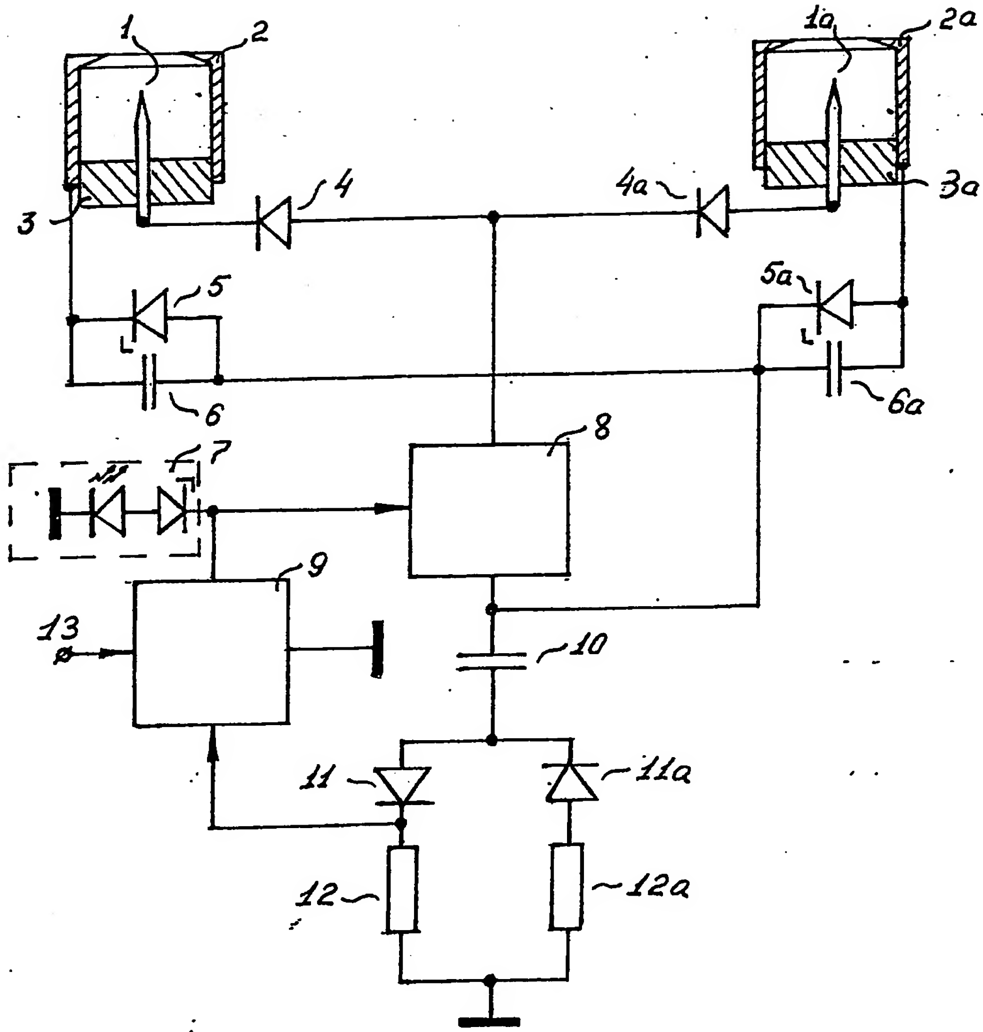

Fig. 2

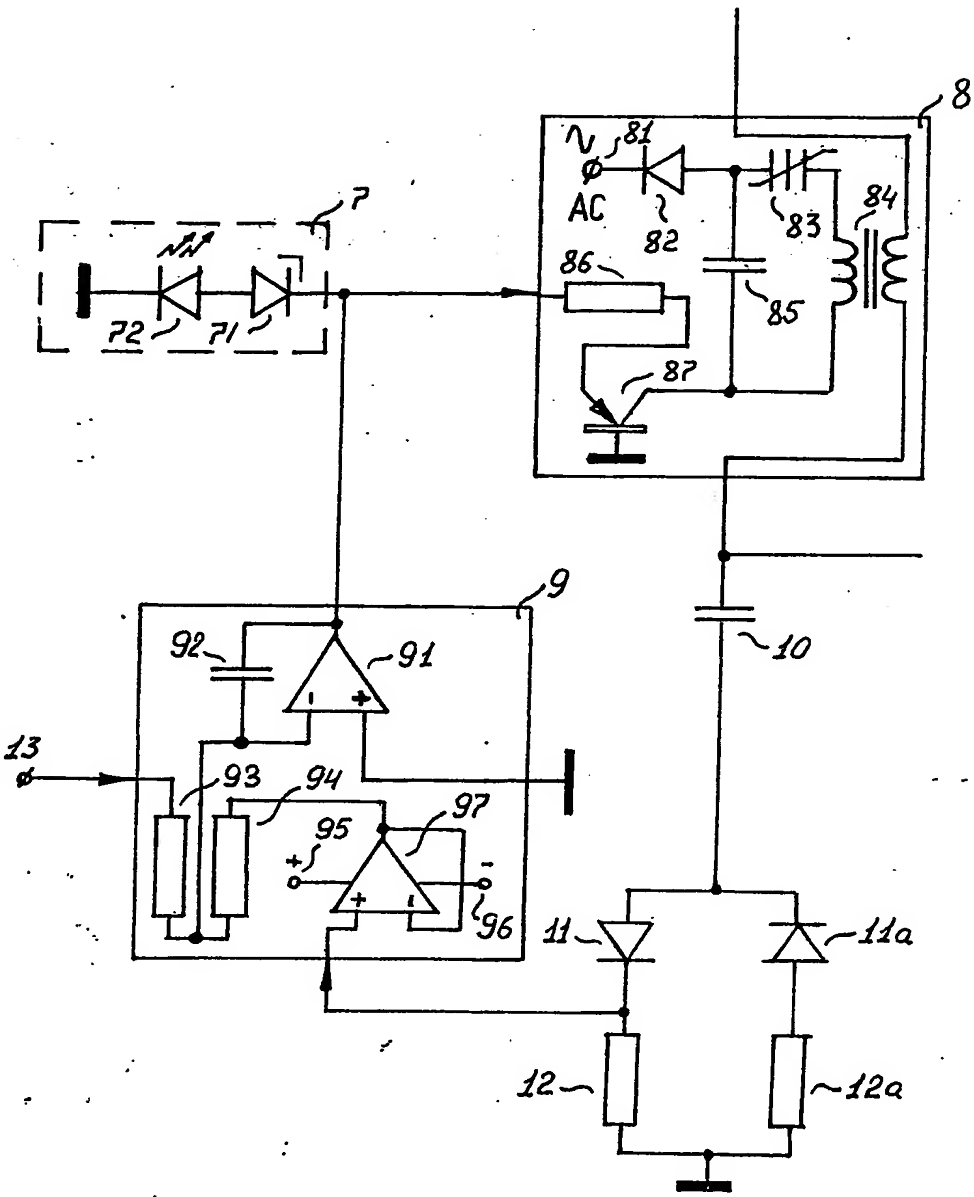
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Fig. 3